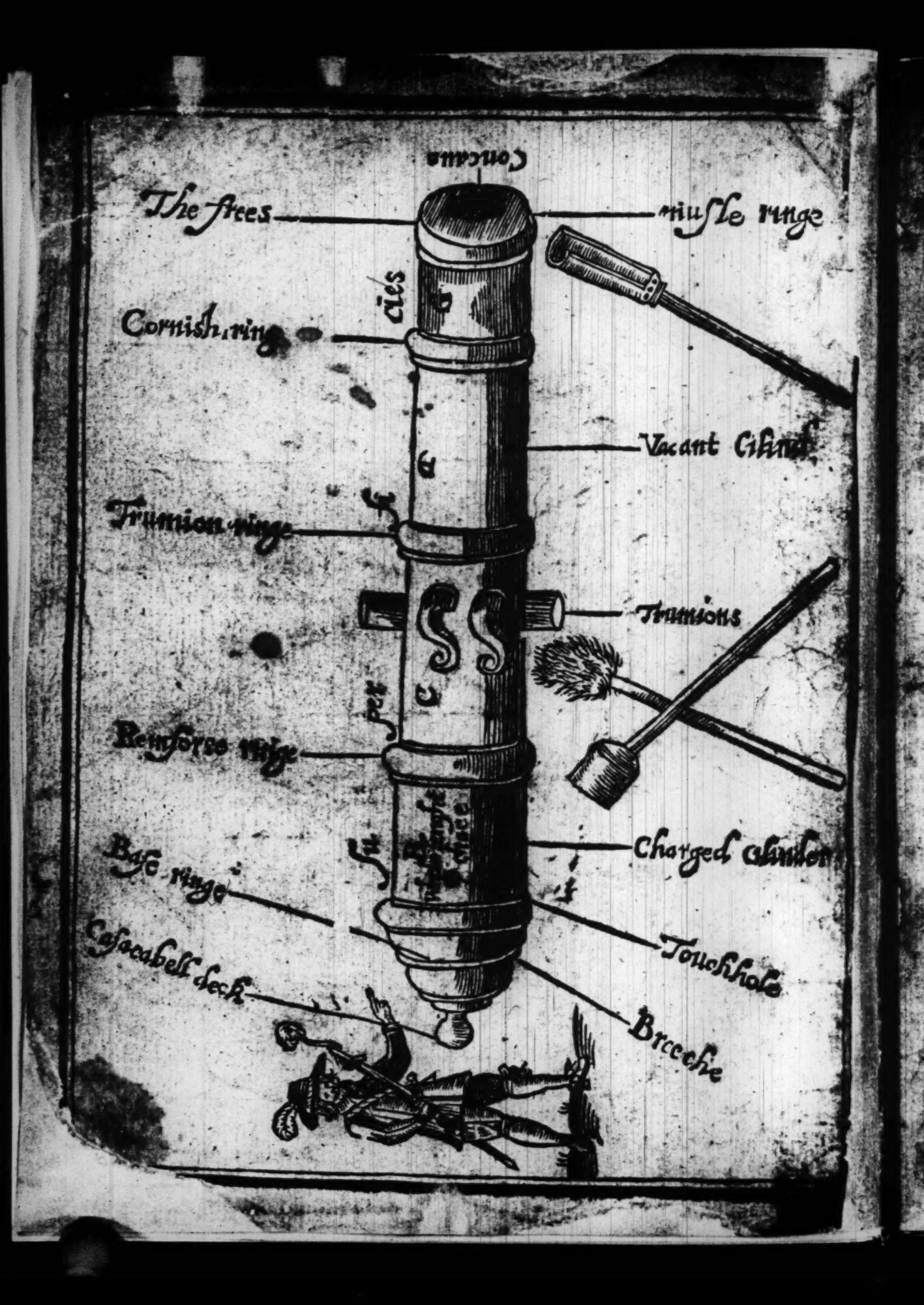
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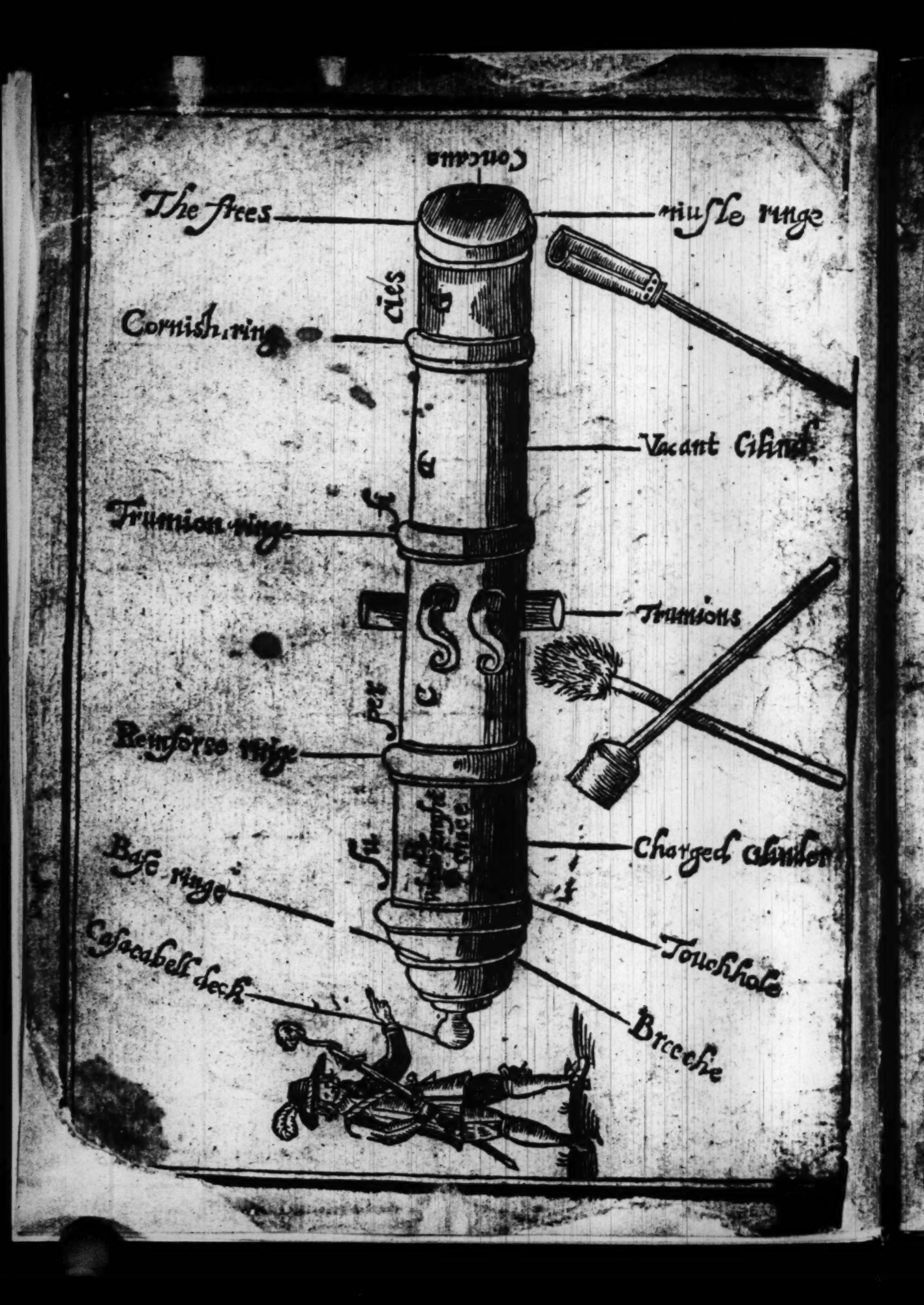
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THE Compleat Cannoniere: OR, The Gunners Guide.

Wherein are set forth exactly the Chiefe grounds and principals of the whole Art, in a very briefe and Compendious forme, never by any set forth in the *like nature before.*

With divers excellent Conclusions, both *Arithmeticall* and *Geometricall* belonging thereunto: As also sundry serviceable *Fireworkes*, both for *Sea* and *Land* service.

A Study delightfull and very usefull for men of the best Quality, and imbrac'd by the greatest Princes.

VIRTVS GLORIAM PARET.

Written by *JOHN ROBERTS* of *Weston* neere *Bathe*, *Gentleman*, Practitioner *and* Professor *in the Arte thereof.*

LONDON:
Printed by [illegible], and are to be sold by *George Hurlock* at his shop in *Thames-street* neere *S. Magnus* Church. 1639.

To the High and Mighty Monarch CHARLES

By the Grace of God, of Great Brittain, France, *and* Ireland, *King, &c.*

SIR,

BEing filled with an admiration of your Royall parts, and a declaratory Fame of the Vertues and heroicke Actions of your Fame worthy Progenitors; and those transmitted unto *You*, by a successive Lineal and Hereditary right, so that that rare Coniunction of *Castor* and *Pollux*, I meane *Majestas & ortu & Arte*, are both happily conjoyned in your most

Sacred Perſonage. The curious ſurvey of the multitude of your Princely parts breed in me a number of deſires ſo that I have adventured to breake the barren ſoile of my poore portion; that proſperous ſucceſſe ſhould rather want to my indeavours, then diligent indeavours to my loyall determination. My ſubmiſſive allegiance to *Your* Royall and Heroicke *Vertues*, have beene an encouraging cauſe to deſire Your Maieſties gracious Patronage of this little *Treatiſe of Gunners Art*; but how my unworthineſſe may hope of your Goodneſſe, I cannot find but in the Notes of Your tranſcendent and gracious Diſpoſition. Thus in the loweſt humility of allegiance, I offer both my ſelfe, and the imployment of my undeſerving Service freely to your Highneſſe acceptance, and do deſire both to be and appeare to be

Your Maieſties humbleſt and moſt devoted ſervant,

Iohn Roberts.

To the right Honourable MOVNTIOY Earle of *Newport*, Lord *Mountioy*, Master of his Maiesties Ordnance.

Right honorable:

THe *favourable countenance and furthering Respect which my Predecessors received of that renowned Generall, and ever memorable and remarkable Martialist the Right Honourable the Earle of* Devonshire, *of never dying Memory, your Lordships late deceased Honour'd Father, together with the Duty and Oblegiance, all those of my Quality owe unto your* Honour; *by reason of the Place and Dignity most deservedly You are in, and called to; makes me of* Socrates *Opinion, in acknowledging all my utmost*

must not able to reach the halfe height of your Lordships Favour: Wherefore labouring like the Bee, sucking from the choycest Flowers the best Honey I can gather, the night of rest being come, I bring it to the Hive of your kind acceptance, and there leave it, as much labour bestowed about little, till diligent imployment may more amply increase it. Right Honourable, *I am loath to be troublesome, especially where affable Gentlenesse out-paceth any merit in my Selfe: Therefore presenting your Lordship with this Treatise of* Gunners Art, *and my attendant Service, when it shall please your* Honour *to imploy me; and praying devoutly for the endlesse prosperity of You, and yours, I humbly conclude*

Your Honours, in all duty
to be commanded.

John Roberts.

The compleat Cannoniere.

And first of principalls of *Philosophy fit to be knowne.*

ALl motions or things moveable endeth in their rest or repose.

So all motions are made upon some quantity continually.

Every simple bodies is either bright and light, or else grosse, darke, and ponderous: and according to the variety and differences, it is alwayes naturally carried towards some one or other part.

The World hath height as upwards, or depth as downewards; and the depth dependeth upon the influence of the height.

All pure and rare Bodies ascend as the fire, more than the aire; but the thicke and grosse bodies descend, as the Eearth more than the Water.

Nothing worketh naturally in that which is wholly like, or wholly dislike, but in that which is contrary to it, and more feeble.

The forme working is aided by the quallities as the matter suffering, which suffereth by the quantity.

Nature is extreamely curious as well of her perfection, as of her conservation? and then when all things conspire.

Aſwell the action that commeth from the Agent, as the paſſion from the patient hath proportion.

Accident taketh his unity from the ſubject, and goeth not from one thing to another.

Every Corporall thing repoſeth in its naturall place, motion may be made any where within the *Moones* Orbe, nature admitteth no Empreſſe.

A body rarifying its ſelfe, the place thereof increaſeth as the body increaſeth.

The reſiſtance of the moved, proportioned to the mover, furthereth the motion.

The longer the chaſe of a peece, the louder the report.

Alſo the force of the ſtroke dependeth on the ſwiftneſſe of the courſe.

A Table of the Square.

1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81

A Table of Cubes.

1	1
2	8
3	27
4	64
5	125
6	216
7	343
8	512
9	729

How to extract the ſquare roote.

SEt downe any number as comes into your minde, as thus, 2 1 6 e 9. Then begin at your right hand, and put a pricke over the firſt figure, and then over the third, as you

you ſee above done; & aske what is the ſquare root of 2. wch is as many figures as you have under your firſt pricke, & you ſhal find but 1. then put that figure in the quotient, and ſubſtract that 1. out of 2. ſo remaineth 1. then double your quotient, & ſet that double under your ſecond figure, dividing the number over by that double. But take heede you leave enough to take the ſquare of that figure laſt ſet in the quotient out of the remainder. Laſtly, double all your quotient, and divide as afore; then ſquare your third figure in the quotient againe, and ſubſtract it out of the remainder, ſo have you done this ſumme. Looke how often you have prickes, ſo often muſt you double and multiply ſquarely, and ſubſtract alſo, ſo many figures alſo will there bee in the quotient, as there are pricks. And conſequently of any number whatſoever.

To know the neereſt root of a number not ſquare.

IF any fraction remaine, by diligent obſervation of this, you may come as neere you would deſire in any practicke, to gueſſe within leſſe than ordinary is knowne. Set next your right hand after your ſumme, either two, foure, or ſixe cyphers, the more, the leſſer your errour; and the nearer by much ſhall you come unto the roote, obſerving the ſame mãner in working as you did before.

And now I will ſhew you by particular queſtions in the art Military, how neceſſary it is for any one intending to be a compleat martiall man, to have good judgement in the extraction of the ſquare and cubicke rootes, and alſo in the depth of Arithmeticke, and what excellencie of knowledge is attained unto thereby, and how farre they are from being Souldiers, as are ignorant thereof.

The firſt Queſtion.

A Generall having 3 great Armies, would caſt them into three ſquare battailes, but he knowes not how

many men he shall set in the front of each battaile.

The number of the 3 Armies are these, in the first there are 5625. in the second 9216. and in the third 15129.

To doe this, you must extract the root of every Armie severally, so have you your desire.

In the first you have 75. men square, in the second 96. men, and in the third 123.

If you were commanded to make a square battaile of all three Armies, adde them first together, then extract the square roote; and if any remainder be, you may imploy them where you please.

The second Question.

A King hath a great Armie in a valley that in marching, the front can be but 18. men, & the flank 44352 which he is desirous to cast into a square battaile.

Multiply the flanke by the front, so have you the full number of the men; then extract the square root thereof, so have you what can be desired.

The third question.

A Generall hath 3 Armies in the Field, to the number of 28289. men, and none of these three apt to make a square battaile; the Serjant Major is commanded by his Generall to set them in three square battailes.

These are the 3 numbers of the three severall Armies: In the first there are 10296. men: in the second 9493, and in the thire 8500 men.

Marke this seriously for it is not ordinary; you shall finde more exquisite worke than you imagine, because the question is more difficult.

First, extract the severall roots of the 3 Armies.

Then take the greatest squares of all 3 numbers, as 10201. and his excesse 95. together with his root, which is 101.

In

In the ſecond the greateſt ſquare is 9409, and his exceſſe 84, and his roote 97.

In the third, the greateſt ſquare is 8464, his exceſſe 36, and his roote 92. And thus have I found the 3 exceſſes.

Now for to end the 3 defaults or wants, I adde one to each roote, and multiply them ſquarely, and ſo of 102. I find the ſquare to be 10404, and if I ſubſtract the firſt number, which is 10296, out of it there will remaine 108 for the firſt want, and thus doe by the other two, ſo your exceſſes and wants will be as are here ſet downe in particular.

	A	B	C
Exceſſes	95	84	36
Wants	108	111	149

Here I compare the exceſſes with the wants, to ſee if any two exceſſes will make up the others want, and I ſee by a light proofe it will not juſtly ſerve.

As for the wants, I doe not compare them to the exceſſes, for every want is greater than the exceſſe: therefore two wants farre too great for one exceſſe.

Wherefore when this rule faileth, take the two wants of any two numbers, and adde them firſt together, then abate them from the third number, and if the remainder be a ſquare number, you have gotten your deſire.

As for example, take the wants of the firſt and ſecond, which makes 219, and that doe I abate from the third number 8500, and there remaines 8281, which I ſee may be a ſquare number, and 91 the roote thereof.

Wherefore I ſay, that theſe three numbers following ſhall be the rootes of the ſquare battailes, as here I have ſet them.

The firſt battaile 10404, *and his Front* 102.
The ſecond battaile 9604, *and his Front* 98.
The third battaile 8281, *and his Front* 91.

The ſumme totall of all the 3 battailes 28289 men.

The fourth Queſtion.

A Generall having 3. Armies in three ſeverall battailes, in the firſt 4900. men. in the ſecond 2401, and in the third 2500. ſo that the greateſt is as much as both the other, except one man, and hee is enforced to joyne all three battailes into one: but is in doubt whether he may have good and convenient ground to encampe them in forme of battaile. Wherefore conſidering that all three battailes together are but double to the greateſt of the three alone: The Serjeant Major deſiring a meere ground for his Army, ſo joyned in one ſquare battaile, is in doubt what ſquare of ground will ſerve his purpoſe; but ſure hee is, that it muſt be double to the ground, that the greateſt Army of the three did uſe, and that was every way 210. foot: wherefore his demand is how many foote ſquare ſhall the ſide of that ground be, that is, double to the former ſquare, whoſe roote was 210. foote.

To double a ſquare.

Firſt multiply 210. by it ſelfe, and ſo have I the juſt plat of ground of 44100 foot; that muſt I double, and it will be 88200. and out of this number ſhall I ſeeke (as before is taught,) the nyeſt ſquare root. For juſt ſquare I ſee it is not, by reaſon that after the even cyphers, there followeth the figure 2. which is one of thoſe figures that cannot begin any ſquare number, therefore (as I ſaid above) you muſt ſeeke the neereſt ſquare root, which for brevities ſake, and becauſe I have ſufficiently already treated of, doe leave it to your beſt leaſure to practiſe. Infinite more queſtions tending to this purpoſe, could I ſet downe, but that time will not permit, or my intended little volume containe, therefore I will proceed to ſhew you the extraction of the Cubicke roote, which will bee much to the purpoſe and ſubject I am now to treat of.

How

How to extract the Cubicke root.

FIrſt, begin at your right hand, and ſet a prick over the firſt figure, then another over the fourth, ſo leave two figures unprickt, and pricke the third ſtill untill you have done thus, 79864345 As many pricks as are over the number, juſt ſo many figures will there be in the quotient.

1 Then aske what is the Cubick root of the firſt pricke, and ſet downe that in the quotient: and if it bee ſo that root doth not take all away of the number from the firſt prick, ſubſtract as much as the roote containeth, and ſet the remander over head the figures which ſtood there before, being cancelled.

2 Then triple your quotient, and that triple you ſhal ſet under the next number towards your right hand, before that pricke which you did laſt end.

3. Next, multiply that triple by the ſame quotient, and ſet it downe under the firſt triple, and that number ſhall be your Deviſor.

4. Now muſt you look out a quotient that may declare how often the deviſor is in the number over it.

5. This being done, you muſt multiply the laſt figure in the quotient by your deviſor, and ſet it under your deviſor, with a line betweene.

6. Then multiply the laſt figure in the quotient by it ſelfe, and then in the triple, and ſet that product below the former one figure more towards your right hand.

7. Laſtly, multiply the laſt figure cubically, & ſet that ſum alſo one figure nearer the right hand: then adde all theſe three multiplications together, and ſubſtract it out of the firſt & ſecond pricks; I meane out of al thoſe figures unto the ſecond prick: this done, triple all your quotient, and divide as before, and as you did by the firſt and ſecond pricks after your diviſion, ſo doe by the reſt, and you have obtained your deſire. Looke upon this following example.

To

To finde the neareſt Cubicke root not cubical.

You muſt doe it by addition of cyphers (as is ſpoken of before in the ſquare root) in ſuch ſort that they muſt be alwayes ternaries, as 3 or 6, or 9 or 12, and then proceed forward with the like order of worke, as before.

```
                18
2 6 4 6 3 5 9 2 (29.
    6
   12
  ---
  108
  486
  729
  ---
```

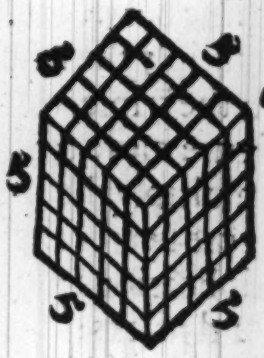
A queſtion of doubling a Cube.

IF the ſide of a Cube be 3 foote, how many foote ſhall the ſide of that Cube be, which muſt be double unto it?

Firſt finde the quantity of that Cube that is propounded, and then double that quantity; laſtly, extract the cubick root of that double number.

As for example, the cube is 3, and therefore the whole Cube is 27, whoſe double is 54, and the Cubick roote is 3 foot, and $\frac{77}{100}$ and $\frac{1}{7}$ of $\frac{1}{100}$.

Cube of 2.



Cube of 5.

A

A queſtion of two Cubes.

A Cube of braſſe of foure inches ſquare, doth weigh 7. pound weight, what ſhall a cube of braſſe of nine inches weigh?

The proportion of their ſides are as $\frac{2}{4}$, which I muſt ſet downe twice, and multiply them together as fractions ſhould be, and ſo will it be thus $\frac{222}{444}$ that maketh $\frac{222}{64}$.

Wherefore I multiply the weight of the leſſer Cube, being 7. by 729. and it maketh 5103. and that doe I divide by 64. and ſo find I 79. $\frac{47}{64}$, whereby I may know, that the weight of the greater cube is 79. pound, and neare $\frac{1}{4}$ of a pound.

A queſtion of a Gunne.

A Gunne of ſixe inches diameter, doth ſhoot a bullet of twenty pound weight, what weight ſhall that bullet be, that ſerves for a Gun of 14. inches in diameter.

All Globes beare triple that proportion, that their diameter does. So in this example, the proportion of their diameters being as 14. to 6. or as 7. to 3. I ſhall triple it, and then have I the proportion of their globes. Euclid

Wherefore I ſet the 3. fractions thus, $\frac{777}{333}$ and they make $\frac{3431}{297}$, that is 12. $\frac{17}{27}$ when you have divided the Numerator by the Denominator. And ſo is the proportion of the globes as well in weight as in bigneſſe. Therefore I multiply 20. that is the weight of the leſſer by the numerator of the proportion, & divide it by the denominator. And ſo ſhall I have 254. $\frac{8}{17}$ for the weight of the greater bullet. Some take more, as now is found.

Another queſtion of a bullet.

A Bullet of Iron of ſeven inches diameter, weighed 27 pound, what ſhall be the diameter of that bullet, that ſhall weigh 125. pound?

I ſet downe $\frac{125}{279}$ and I ſee the cubicke root of 125. is 5, and the like root of 27 is 3; which numbers I ſet in the roome of the other thus $\frac{5}{3}$ which declare the proportion between the diamiters of the two bullets. The diameter of the leſſer is knowne to be 7. Therefore I multiply that 7 by 5, whereof commeth 35: that divided by 3, yeeldeth in the quotient 11.

The proofe hereof.

Multiply both roots cubically, if their roots be in proportion as their weights, then is your work true, elſe not. As for example, 7 multiplied cubically, make 343, and $11\frac{2}{3}$ multiplied alſo cubically, makes $428\frac{11}{27}$.

To multiply a fraction cubically, as $11\frac{2}{3}$ firſt reduce it, and make it $\frac{35}{3}$: that 35. multiply cubically, you have your deſire.

How to turne a whole number into a fraction of the like denomination.

SVppoſe 7 is the number you deſire to turne into the like denomination, that is $\frac{2}{3}$ (as above) is of, Multiply 7. by 3. the denominater of the other fraction, and it maketh 21. that 21 multiply cubically, and it will be $\frac{21\,61}{27}$: Theſe few rules diligently obſerved, will much enable an Arteſt to perform many things belonging to this ſubject, alſo much benefit, experience, and delight, ſhall any man reape, that hath judgement to try and practiſe the ſecrets thereof.

A queſtion of whole numbers and fractions.

A Faulcon of 2. inches in the diameter ſhoots a bullet of 3. pound, what ſhall the Culvering ſhot weigh, whoſe diameter is 5. inches $\frac{1}{4}$.

To anſwer this and all ſuch queſtions that muſt be cubically multiplied, you muſt reduce each bullet into his proper

proper fraction. As for example, $2\frac{1}{4}$ maketh $\frac{11}{4}$ and alſo $5\frac{1}{4}$ maketh $\frac{21}{4}$ then I multiply each numerator cubically, and I find the Cube of the leſſer to bee $\frac{1111}{4}$ and the Cube of the greater to bee $\frac{9261}{4}$. Then I ſet downe 3, the Diameter of the leſſer fraction like as before thus $\frac{3}{1}$ which being wrought punctually by the rule of three in fractions, you ſhall have for the weight of the bigger bullet 20. pound, and almoſt $\frac{1}{4}$.

How you Geometrically finde out the Diameter of any bullet that weigheth twice ſo much as a knowne bullet.

TAke the true weight or diameter of the leſſer bullet, whoſe weight you know, and ſquare the ſame as in the figure following: Then draw a line that may divide the ſaid ſquare into two equall parts, in the 2. oppoſite angles, and that line ſhall be the diameter of a bullet, twice the weight of the other; then divide that diametriall line in 2. equall parts, ſetting on foote of your compaſſe in the Center, and with the other foote draw a circle. and that circumference will repreſent a bullet twice as much in weight as the leſſer.

To prove it Arithmetically.

THe diameter of the leſſer bullet is 5. inches, the ſquare 25. that ſum double is 50. the ſquare roote of 50. is 7. and ſomewhat more, and ſo much is the diameter of the greater bullet.

By one bullet to know the weight of another, the Diameter given.

A Canon of 7. inches, ſhootes a bullet of 32. pound: I demand what weight that bullet ſhall be of, that is 9 inches in the Diameter.

Multiply the Diameter of each Bullet cubically, as 7. times 7. is 49. and ſeven times 49. is 343, then 9. times 9. is 81. and 9. times 81. is 729. then by the rule of 3. ſay, if 343. give 32. pound, what ſhall 729. give? Multiply and divide, and your quotient will be 68. $\frac{4}{343}$.

How by the weight of one Peece, to know the weight of the other.

IF a Minion of three inches Bullet, weigh 500. pound, I demand how much a Cannon of 8. inches bullet will weigh, that is able to receive his proportionall charge to the Minion. The Cube of 3. is 27. the Cube of 8. is 512: now by the rule of proportion ſay, if 27. give 512, what ſhall 500. give? multiply 512. by 500. and divide tha product by 27, and you will have in the quotient 9481. $\frac{23}{27}$ the true anſwer to the queſtion.

The Cannon therefore that ſhall be able to carry a proportionall charge to the Minion, muſt have 9481 $\frac{23}{27}$ pounds of mettall: but becauſe commonly thoſe greater ſorts of Ordnance are not ſo maſſie of mettall as indeede they ought to be. The Gunners obſerve this for a generall rule, that in all peeces of above 6. inches in bore, they abate $\frac{1}{4}$ of their ordinary charge.

To know how many ſhots of Pouder will be in a grand Barrell of Pouder, for any Peece.

SVppoſe a Culvering ſhoot 10. pound at one ſhoot, how many times will a grand Barrell of Pouder ſerve the

the Barrell holding three hundred weight?

Example.

Divide 300. by 10. the quotient is 30. your desire.

The proofe.

Multiply 30. by 30. or 30. by 10. gives 300. so may you know for all other sorts of Ordnance whatsoever.

By knowing what pouder a Piece must have, to know how much a piece of another bore will require; but, Cave.

IF a Minion of 3. inches the Bullet, requires 3. pound of pouder for his charge, what pouder will a Cannon of 8. inches bullet require?

Multiply 512. the Cube of 8. by 3. the charge of the Minion, and it maketh 1536. which divide by 27. the Cube of 3. the Diameter of the said Minions Bullet, so have you in the quotient 59 $\frac{8}{27}$, so many pound of powder is the due charge of your Cannon, but by the rule aforesaid you find the Cannon hath not his proportionall mettall, therefore you ought to abate $\frac{1}{4}$ of the powder, so will there remaine 44. pounds, or neare for your Cannons charge.

To finde the superficies of a Bullet.

FIrst, by a paire of Callibres finde out the Diameter, which suppose it be 7. then must the circumference be neare 22. but for speedy worke, and to avoyd a tedious discourse thereof, being that no great errour ensueth thereby, take 22. now multiply that number by 7. it produceth the superficiall content of that Globe, ball, bowle, or bullet.

A Table shewing the weight of all Iron Bullets, in Haberdepoize weight.

Height of the Shot, in inches and parts.	Weight of the Shot in pound & parts.	Height of Shot in circles & parts	Weight of Shot in pounds and parts.
Height.	Weight.	Height.	Weight.
2	1 2/7	5 1/2	19 2/3
2 1/4	1 1/2	5 3/4	22 1/7
2 1/2	2 1/3	5 1/4	25 1/6
2 1/4	3 1/7	6	29 1/2
3	4 1/2	6 1/4	32 1/8
3 1/4	5	6 1/4	40 1/4
3 1/2	6 2/9	7	46
3 1/4	7 2/7	7 1/4	52 2/7
4	9	7 1/2	56 1/8
4 1/4	10 1/4	7 1/4	64 1/2
4 1/2	12 2/3	8	70
4 1/4	14 1/8	8 1/4	76 2/3
5	16 1/4		

To find out how many square inches are contained in a solid content of a bullet, and consequently, how many pound weight.

THere is a bullet whose diameter is nine inches, how many square inches are there in the solid content?

Multiply

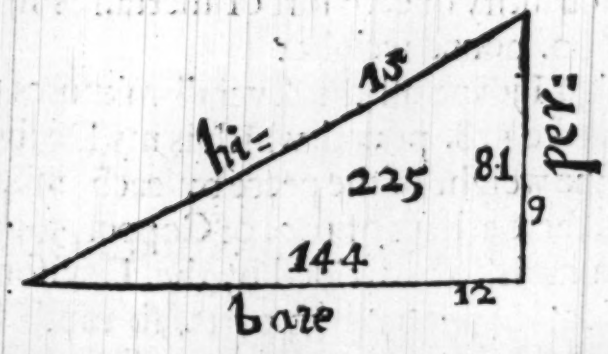
Multiply the diameter 9. cubically, ariſeth 729. which multiply againe by 11. maketh 8019: that divide by 21. yeeldeth 381 inches and $\frac{4}{7}$: ſo many inches are in a bullet of 9. inches diameter. Now to know how many pound weight is contained in that globall body, multiply that quotient 381 $\frac{4}{7}$ by 4. and divide by 16. it will ſhew how many pounds of Iron that bullet weigheth: for an inch ſquare of caſt Iron, weigheth foure ounces *ferè*.

To finde the true content of a circle.

TAke the one halfe of his diameter, and multiply it in one halfe of the circumference, and it produceth the *Area*, or ſquare the diameter, and multiply the product by 11. and divide the reſult by 14. and it alſo ſheweth the content.

Arithmetically to finde out the meane proportion betweene two numbers.

MUltiply both numbers one in another, and then extract the ſquare root, ſo have you the meane proportionall.



Suppoſe the line given is 12. and the perpendicular 9. now you muſt multiply 12. in it ſelfe, and it maketh 144. then

then multiply 9. in it ſelfe, and it maketh in product 81. then adde both the multiplications together, and it maketh 225. Laſtly extract the ſquare root, and it leaveth 15. the juſt length of the hypothenuſall ſought.

Geometrically to finde the meane proportion betweene two lines.

EXtend one of the lines to the number of inches he is in length, upon the end whereof erect a perpendicular to the juſt length of your other ſuppoſed line: then that line which is the hypothenuſall to them both, is the meane proportionall.

The hypothenuſall and one ſide given, finde the other.

MUltiply each number in it ſelfe: then ſubſtract the leſſer out of the greater: the ſquare roote of the remainder is the true length of the third ſide.

Arithmetically to know how much of every ſort of mettal is in a peece of Ordnance.

FOr every hundred pound weight of Copper, to put in ten pound of Lattin, and eight pound of Tin. I demand the quantity of each ſort of mettall is in a Culvering of 5600. pound weight?

Note that I joyne all the ſeverall mixtures together, and they make 118. pound, which is my Deviſor: then I multiply the weight of the peece by each mixture ſeverally, and there ariſeth of 100. of Copper 560000: the which ſumme is to be divided by the Deviſor 118. and the quotient is 4745. and $\frac{20}{118}$ parts, ſo much Copper is there in that Ordnance, and thus muſt you doe to know how much you have of the other two ſorts of mettall.

To

To prove this, adde all three quotients together, if they make the summe before mentioned, it is right.

The Latten doth incorporate, and causeth the peece to be of a good colour, and the Tin doth strengthen and binde the other mixtures together.

To finde the superficiall content of the hollow concavity of a peece of Ordnance.

SUppose the diameter be 7. inches, and the cilinder 12. foot, what is the content superficiall?

Reduce the Cilinder 12. foot into inches, maketh 144. which multiplied by 22. the circumference of the muzell ariseth 3168. the superficiall content of the metall compassing the hollow cilinder.

To finde the crassitude, or solid content of the Cilinder of any peece.

FIrst multiply one halfe of the diameter, in one halfe the circumference, or else square the diameter, and multiply that product by 11. and divide the result by 14, the quotient will shew you the content: the which multiply in the length of the Cilinder, the product is your desire.

If you desire how many foot in square measure it containes, divide the number of inches in the solid content, by the number of inches in a foot square, which are 1728. your question is resolved.

To measure any sort of Timber.

SUppose your timber be 8. inches one way, and 6. inches another way, and you are desirous to know how many inches in length will make a foot square.

Multiply 8. by 6. and it maketh 48. which number di-

vide 1728. (becauſe there are ſo many inches in a foote ſquare) and you ſhall have 36. inches in the quotient, ſo many inches long will make a foot ſquare of Timber. Thus of all other cubically.

A Table how to weigh a great deale with few weights.

You may weigh any number of pounds from

One to 40. with these 4. weights. 1, 3, 9, 27

One to 121. with these 5. weights. 1, 3, 9, 27, 81

One to 364. with these 6. weights. 1, 3, 9, 27, 81, 243

The pounds to be weighed, are weighed with as many namelike weights, to be done either double or threefold: ſometimes by adding one weight to another, and ſometimes by taking away and adding to the contrary ballance.

To

To meaſure any ſort of board, glaſſe, pavement, &c.

FIrſt multiply the breadth by the length, as a board is 17. inches one way, and 139. inches another way, multiply 139. by 17. and it maketh 2363, which divided by 144. leaveth in the quotient 16. foot and $\frac{12}{144}$ parts of a foot. Note that in flat meaſure there is but 144. inches in a foot, but in ſquare meaſure 1728.

To meaſure Land.

MUltiply the breadth by the length (if ſquare or long ſquare) and divide the product by 160. becauſe there is 160. ſquare perches in an acre, ſo ſhall you come to the *Area*, but if your ground be irregular, you muſt caſt it into triangles; & if it be a right angled triangle, multiply halfe the perpendicular by the whole baſe, and divide it by 160: but if it be an obtuſe triangle, let fall a perpendicular from the obtruſe angle to the baſe, and multiply halfe the length of that perpendicular by the whole baſe, and divide by 160. as before, you have the content.

Alſo if you have a peece of Land to ſet out, as to know if it be 12. Perches in bredth, how many perches it ſhould be in length, ſay by the backward rule of 3. if 4. gives 40. what ſhall 12. give? multiply, 4. by 40. makes 160. which divided by 12. and it giveth 13, perches, and $\frac{1}{3}$ ſo of all ſuch like.

To meaſure any irregular ſubſtance what ſoever, as a crowne, Horſe-head, or any Image, or concaved peece.

TAke a veſſell that is very ſtanch, and 4. ſquare, and put water into it, & when the water is ſetted, marke with

your knife how high it riſeth in the Veſſell, and then put in your irregular forme whatſoever it be, & marke with a knife againe how high the water then beares, or riſeth; then take out the irregular forme againe, and meaſure exactly the ſpace betweene the markes, and multiply the breadth by the thickneſſe, and obſerve the length, and you have your deſire.

How by knowing the weight of one Fathome of Rope, to know the weight of another.

A Cable of 10. inches compaſſe weighing 16. pound every Fathome, how much will a Fathome of that Rope weigh that is 15. inches in the Diameter, and made of the ſame ſtuffe?

Multiply 15. the greater in it ſelfe maketh 225, and that multiplyed by 16. the weight of a Fathome of the leſſer Rope, maketh 3600. which divided by 100. being the ſquare of the leſſer rope, leaveth in the quotient 36. pound, the true content.

By the compaſſe of any ſmall rope, to find the Diameter and weight of one, foure, five, or ſixe times as bigge.

SUppoſe the ſmall rope is 3. inches compaſſe, and that it is required to know the height of another 5. times that compaſſe, multiply the number 3. ſquarely ariſeth 9. which multiply againe by 5. maketh 45. then extract the ſquare roote thereof, and you ſhall have 6. $\frac{1}{2}$ ſo much in Diameter is the greater, that done, you may as before finde his weight and circumference.

How

How to know what empty Caske will carry any sort of Ordnance over a river.

IT is thought sufficient, 5. Tun of Caske will swimme a Cannon of 8. or. 9000. weight, 4. Tun a Demi-cannon, 3. Tun a Culvering, and two Tun a Saker, accounting all provisions to be made fast thereunto, as plankes & ropes.

How, by knowing what powder a few peeces spend, being seldome discharged, to know how much many of the same will spend being often discharged:

IF 4 Cannons bee twice discharged, and shoot 240. pound of powder, how much powder will serve 5. Cannons, to shoote every one 6. shoot, worke by the double rule of 3. and say, if foure Cannons shoote 240. pound, what shall 5. doe? and you shall finde 300. then say againe, if 2. give 300. what shall 6. give? multiply and divide, and you shall have in the quotient 900.

To know how much powder each Cannon spent in the former conclusion at a shot.

MUltiply 4. the number of Gunnes first propounded, by 2. the number of times they were discharged, ariseth 8. by which divide 240. the quotient will be 30 which they spent at a time.

The proportions betweene Bullets of Iron, Stone, and Lead.

A Bullet of Iron to the like bullet of Marble, is in proportion as 15. is to 34.

A Bullet of Lead to the like of Iron, is in proportion as 28. to 19.

A Bullet of Lead to the like of Marble, is in proportion as 4. to 1.

By knowing the Diameter and weight of an Iron Bullet, to finde the weight of a Bullet of Marble.

ADmit an Iron Bullet weigh 9. pound, of 4. inches high, what shall a Bullet of Marble weigh of like Diameter?

He shall have such proportion as 34. to 15; therefore multiply 9 by 15. the proportion of the Stone bullet beareth, and there ariseth 135. which divided by 34. the quotient is 3. pound, and $\frac{11}{34}$ parts of a pound.

How to know Arithmetically where to place the Trunnions of any peece of Ordnance.

MEasure the length of the bore of the peece from the muzle to the breech; divide that measure by 7. and multiply that summe that commeth of the quotient by 3. the product will shew you how many inches the trunnions must stand from the lowest part of the concavity of the peece.

And farther note, that the trunions ought to be placed as $\frac{2}{3}$ of the circumference of the peece may be seene in that place where the trunnions are set.

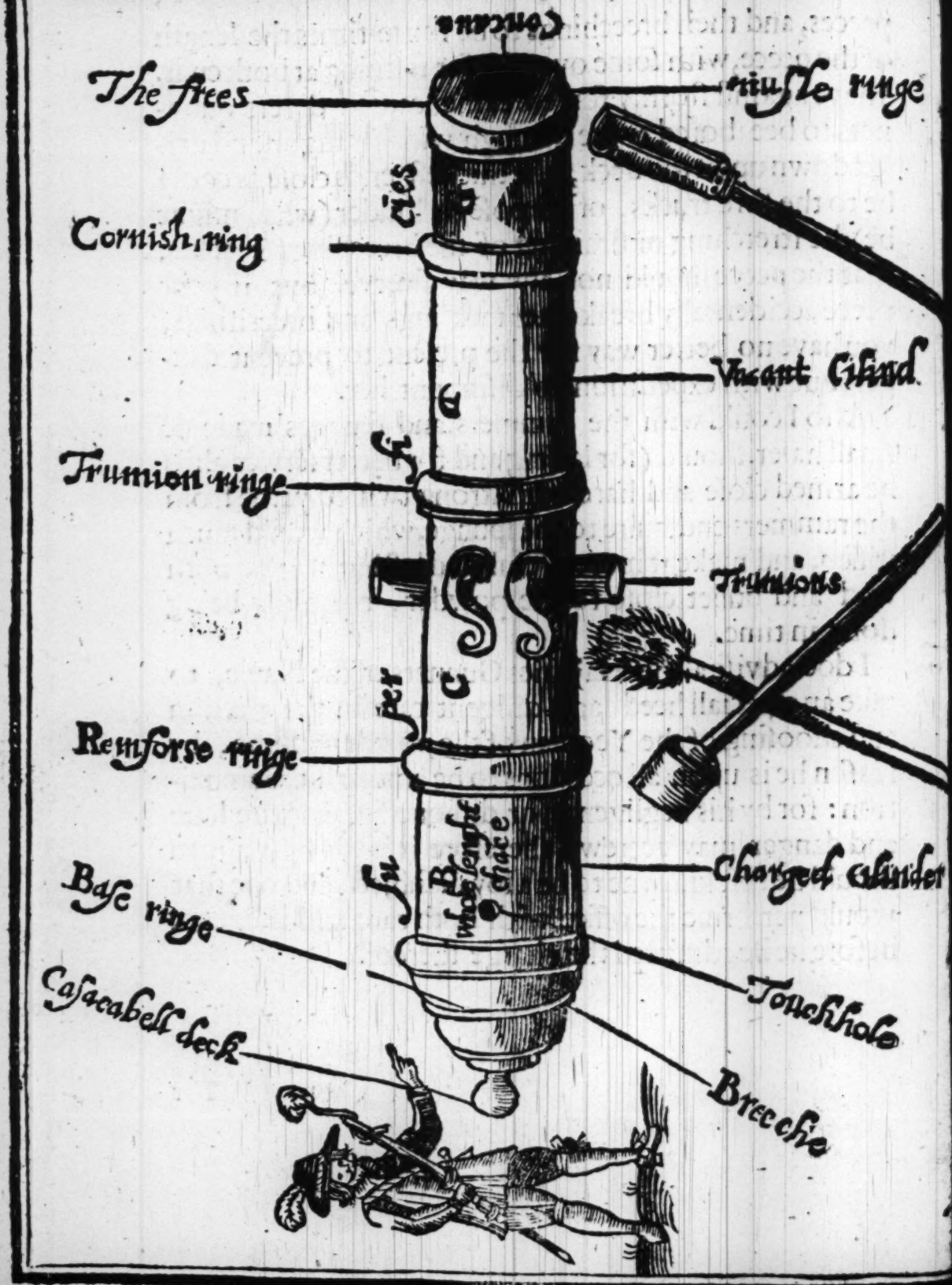
How much rope will make breechings and tacklings for any peece.

IT is a rule, though not observed by the vulgar, yet by the most experienced Sea Gunners, that looke how many foot your peece is in length, so many fathome of rope must there be in one tackle for ordinary or extraordinary peeces,

peeces, and their breechings to be foure times the length of the peece, with some overplus for fastning at both ends. I have against stormy foule weather caused divers quoyners to bee bored twice through with an augor, and nailed down upon the deck, the thickest ends close as could be to the fore trucks, of purpose to hinder (what might be) the stretching or straining of the breechings & tackle, that the peece should not any way swerve. But if your peece accidentally breake her tacklings and breechings, you have no better way for the present to prevent danger, but with expedition to dismount her.

Also I could wish the rammers and spunges made of small haser, should (for lasting and for better service also) be armed close and hard with strong twisted yarne from the rammers end quite to the spunge, which would much stiffen, and make it more usefull and lasting to ram both wad and bullet close to the powder, especially being done in time.

I doe advise all his Majesties Gunners of the Navie, to take an especiall heed, and diligent care in the election and choosing of the Yeoman of the powder-roome, by reason he is upon all occasions to be amongst the amunition: for by his negligence or dishonesty, infinite losse and danger may accrew; therefore it is fit such a man should be first knowne to be a loyall subject, and one that would performe the office with both care and diligence before he be admitted the charge thereof.


The frees
muzzle ringe
Cornish ring
Vacant Chase
Trunion ringe
Trunions
Reinforse ringe
Charged chamber
Base ringe
Touchhole
Cascabell deck
Breeche

The names of the principall members of a peece of Ordnance.

FIrſt, the uppermoſt part round about the peece, may be called the Superficies of her metall; the ſubſtance or whole maſſe of mettall, the Body; the hollowneſſe thereof, the Concave, Cillinder, or Soule: the whole length, the Chaſe: So much of her Bore as containeth her powder and ſhot, is the Chamber, or charged Cillinder; the remainder her vacant Cillinder; the Spindals or Eares are called her Trunnions; and the ſpace between them, the gravity of her Center; the pumell at her coyle, the Caſacabell, or her Decke: the little hole, the Touch-hole; all the metall behind the touch-hole, her breech, or Coyle, the greateſt Ring at her touch-hole, her Baſe Ring; the next Ring, or Circle, is the reinforſt Ring; the next to that, the Trunnion ring; and the circle foremoſt, her Muzzle Ring. Laſtly, the Ring betweene the Trunnons and Muzzle ring, is called the Corniſh ring; and all the Rings, Circles, and emenencies at her Muzzle, are called the Frieze, as you may ſee in the figure juſt againſt this matter.

What inſtruments are moſt fit for a Gunner.

THe Callabre Compaſſes, height board, inch ſight-rule, Gunners ſcale, Gunners quadrant divided into 90. degrees, and into 12. poynts, & their minutes, with a Geometricall ſquare to take mountures, levels, heights, breadths, and diſtancies: a paire of ſtreight pointed Compaſſes, with a little braſſe levell, ſcales and weights, Priming Irons, moulds to make croſſe-barre ſhot for Muskets, a faire Booke for your accompts, and an Iron with a Spring and a Tranſome to diſpart a Peece of

Ordnance; let the Tranſome bee to goe up and downe, according to the diameter and thickneſſe of any peece; let the Tranſome be long enough to reach the Baſe-ring from the Touch-hole. This Inſtrument is very neceſſary, though not commonly knowne.

How to loade and fire a Peece of Ordnance like an Artiſt.

HAving all things fitted, and in readineſſe prepar'd for ſervice, firſt, marke the winde, and be ſure to lay your budge-barrell, and the reſt of your powder to weather your Peece, then place your Lindſtocke to leawards, having clear'd the Touch-hole, ſpunge her well, ſtanding by the right ſide of the Gunne, and when he drawes out the ſpunge, ſtrike two or three blowes upon the muzzle, to beate off the foulneſſe of the ſpunge; then his aſſiſtant declining the Budge-barrell aſide, hee ſhall thruſt in the Ladle to fill it, ſtriking off the heaped powdes, and giving a little ſhogge, the better to ſettle the reſt in in the Ladle; ſo being filled and ſtriked, ſtand by the right ſide of the Peece, (as cleare as hee can from the muzzle) and put in the Ladle to the bottome of the concave very ſteddy quite home to the touch-hole, and when it is arived to the bottome of the bore, laying your right thumbe upon the upper part of the Ladle-ſtaffe, turne the ſtaffe, untill your thumbe be quite under it, and give a ſhake or two to free the powder from the Ladle, bearing him up, that none may come out againe: Then put the powder home ſoftly with the Rammer, after which put in a good wadde, and thruſt it home to the powder, giving three or foure hard ſtrokes, which will gather the ſcatter'd powder together, that it may fire the better, the aſſiſtant having a thumbe upon the Touch-hole all the while

while, then put in the ſhot, which with a Rammer he muſt put ſoftly home, and afterwards another wadde and then give two or three good ſtrokes with the Rammer more, to ſettle all cloſe together, that there may be no vacuity betweene powder, firſt wadde, bullet, or laſt wadde: This done, place your Budge-barrell againe to wind-wards, and be ſure to weather your Peece in the fiering, to prevent all danger. Laſtly, have ſpeciall care in directing her to the marke, and in priming her, let the powder come from the Touch-hole to the baſe ring, ſo may you fire there ſafely, without danger of the fire of the Touch-hole to force your Lintſtocke out of your hand, provided you draw backe your hand in the fiering, your leg ſtanding forwards, and ſo doing, the Peece will be loaden, and fier'd Gunner like. Some uſe to prime before the Touch-hole forwards two or three inches, and fire there; for the bigger the Touch-hole is, the more care muſt bee taken in priming, and eſpecially in fiering.

What powder is allowed for proofe, and what for action of each Peece.

FIrſt, I will begin with the biggeſt Peeces, as withall ſorts of Cannons, for proofe $\frac{4}{5}$ and for ſervice $\frac{1}{2}$, of the weight of her Iron ſhot. For the Culverings, the whole weight of their ſhot for proofe, and foraction, $\frac{1}{3}$ and for the Saker and Faulcon $\frac{4}{5}$, and for leſſer Peeces, the whole weight in action, untill they grow hot; for then muſt abatement bee made with diſcretion: But in proofe the leſſer Peeces ſhould have once, and $\frac{1}{3}$ of the powder that the Bulletweigheth.

If Weights, Scales, and Ladles be wanting, how many Diameters of a bullet will make a reasonable charge in powder for any peece named.

FOR the Cannons 2 $\frac{1}{2}$ for Culverings 3. and for the Saker 3. $\frac{1}{2}$ for the lesser peeces, 4. Diameters of the Cillinder. For 3. Diameters makes $\frac{2}{3}$ and 3. $\frac{2}{3}$ makes $\frac{4}{5}$ and foure diameters and a halfe makes the whole weight of a cast Iron shot, it being corne powder, which length will also serve for Cartredges for the like peeces.

How Moulds, Formes, and Cartredges are to be made for any sort of Ordnance.

CArtredges are made of Canvas, or paper Royall; which prepared, take the height of the bore of the peece, without the vent of the shot, and cut the cloth or paper of the bredth of three such heights, and for the Cannon in length three diameters, for the Culvering foure diameters, for the Saker, Faulcon, &c. $\frac{1}{2}$ of the height of their proper bores, and leaving in the middest, at the top or bottom, one other such height, to make a bottome for the Cartredge, cutting each side somewhat larger for the sowing and glewing them together, having a due respect for the augmenting or diminishing of your powder, according to the goodnesse or badnesse of the powder, and to the extraordinary over-heating of your peece. Having resolved for what sort of Ordnance your Cartredges are to serve, you are accordingly to have a former of wood, turned to the height of the shot, and a convenient length longer than the Cartredge is to bee: and before you paste your paper on the former, first tallow him, so will the paper slip off without staying or tearing.

tearing. If you deale with taper-bored Gunnes, your formers must be made accordingly tapred. If you make your Cartredges of Canvas, halfe a diameter more is allowed for the seames; but if of paper $\frac{1}{3}$ or $\frac{1}{4}$ of an inch over-plus for the pasting, will serve, being lapt once about the former, having a bottome first fitted upon the end of the former, which must bee hard and close pasted to the lower sides of the Cartredge; and then the bottome pasted also down hard round about: then dry them well before you fill them, and marke every one with inke or blacke lead, how high they ought to be filled, and let some want of their weight against times they are overhot, otherwise great danger may ensue.

To make Ladles, Rammers, and Spunges of all sorts of Ordnance.

IT is fit every Gunner should know how to trace, cut out, and also make up and finish all manner of Ladles, Spunges and Rammers, and to direct others how they should and ought to be severally fortified, made and distinguished, as followeth.

For double fortified Cannons to charge them with two Ladle fulls, they are to be two diameters and a halfe of their shot in length from the head of the Ladle staffe, which shall be one diameter more of plate, which must goe about the said head. The brasse plate must bee in bredth two diameters unto the said head, where each side must have halfe a diameter more to inclose the head of the Ladle staffe within the plate.

The Button or head of the Ladle staffe must bee one diameter, and of such height or thickneſſe, that it together with the brasse plate, may be equall to the height of the shot (due vent abated.) For Spunges their bottomes

or heads are to be made of ſoft faſt wood, as Aſpe, Birch, Willow, or ſuch like; and to be one diameter, and $\frac{2}{3}$ in length, and not above $\frac{2}{3}$ of the ſhots height. The reſt being covered with raw ſheeps skinnes wooll, and nailed on with copper nailes, ſo that together they may fill the concave of the peece.

The Button or head of the Rammer muſt be turned of hard wood, in length one diameter, and $\frac{2}{3}$ of ſuch height & thickneſſe, that it may fitly enter into the peece, the ſhots vent allowed: it were the better for faſhion and ſtrength, if that $\frac{1}{3}$ next the ſtaffe were handſomely turned with abatement, and a Ferrill or circle of braſſe fitted thereon to ſave the head from cleaving, when as with force wee ſhall ram the ſhot home. All theſe heads and buttons muſt be pierced $\frac{2}{3}$ with a hole for the ſtaffe, an inch or more, whereinto the ſtaffe muſt be faſtened, let the ſtaffe be one foot longer then the concave of the Gunne.

For the ordinary Cannons the Ladles muſt bee of the ſame breadth, but muſt not ſurpaſſe 2. diameters of the ſhot in length. And for the leſſened Cannons, two diameters onely to loade at twice, all according to the faſhion and breadth as before.

The Ladles for Culverings and Demi-culverings, have foure Diameters of their proper ſhot in length, and two in breadth.

The Sakers, Faulcons, and Faulconets, which may at one Ladle full be loaden, may have their Diameters of ſeven diameters and a halfe of their ſhot in length, beſides that coverture of the head of the ſtaffe, and of breadth two; as all the reſt have.

For Periors, which uſually have Chambers with Orloes $\frac{1}{2}$ and $\frac{1}{3}$ leſſe in bore then their Chaſe containeth, to them three times the diameters of their Chambers may be allowed for the length of their Ladles.

How

How to make a Ladle for a chambred bored peece.

YOur Compaſſes opened to the juſt diameter of your chamber within $\frac{1}{8}$ part of an inch thereof, divide that meaſure juſt in two equall parts, then ſet your compaſſes to one of them, and with the one foote fixed on a paper or ſmooth boord, draw with the other foote a circle, the diameter whereof will be a juſt quarter of an inch ſhorter than the diameter of the Chamber bore, by the Circumference whereof you may find out the bredth of the plate of a Ladle that is fit for ſuch a Chamber bored Cannon, by the rule afore ſet downe how to finde the true breadth of the plate of any Ladle for any other peece in taking the three fifts parts of the circumference thereof, the length ought to be twice the diameter, and $\frac{2}{3}$ parts to hold at two times the juſt quantity of corne pouder.

Example.

The diameter of the circle drawne for any Cannon whoſe chamber bore is 7. inches, containeth 6. $\frac{1}{4}$ the Circumference whereof is neere 21. inches $\frac{4}{7}$ and $\frac{1}{5}$ parts thereof is 12. $\frac{1}{4}$ and ſo much ought that Ladle to be in breadth, and in length 18. in the $\frac{2}{3}$ parts. By this rule you may make a Ladle for any tapred peece.

Take this for a generall obſervation, that a Ladle 9. bales in length, and 2. bales in breadth, will neare containe the juſt weight in powder that the Iron ſhot for any peece weigheth.

How

How to finde the height of the Chamber, and how to find the the thickneſſe of Metall round about the Chamber of any tapred peece.

TAke a ſtreight peece of wyre, and bow the end thereof in the bottome ſo as it may goe through the touch-hole, then put it to the bottome of the bore in at the touch-hole, and with any thing marke the wyre upon the upper part of the Metall, then meaſure by your rule how long the wyre is from the ſtroke to the end; Then put in the ſame wyre againe, and put it up ſo as the bowed end may reſt within the Cillinder, and make another marke on the ſaid wyre hard by the upper part of the metall, round about the Chamber, the which abated from the firſt ſtroke to the loweſt end, the remainder is the Diameter of the Chamber bore in that place. This needeth no example.

To know whether the carriage of your peece be truely bord, and how to make them for any peece.

MEaſure the length of the Cillinder of your Gunne, the plankes of your carriage ought to be once and a halfe that length. Alſo meaſure the Diameter, and the plankes at the fore end ſhould bee in depth 4. times the Diameter, and at the end next the ground two times ½ the Diameter, and in thicknes once the Diameter.

How you may finde whether a peeee have any flawes, cracks, or honey-combes.

AFter you have clear'd her, put a uſuall ſearcher made of two or three ſprings, with points, like great pinheads bending outwards, which being bended together with your hand, untill it will enter into the Peece,

and

and put up to the touch-hole, or bottom of the Cilinder, turning it round in putting it in, and pulling it out of the Chace; and if any honey-combes be therein, it will sticke with the poynts therein. Also in a Sun-shine day with a Looking-glasse, the Sun-beames may be reflected into the Chace, as that the flawes, cracks, and honey-combes may be discerned. But if the Sun shine not, a waxe-candle put upon a halfe pike will also shew them: If no flawes be found, proceede to her proofe, but if any be therein, the Peece is indeed very dangerous both in fiering, and loading; and if it can possibly be prevented, not to be used at all, but with great care and good respect first had in her proofe.

The allowance for vent, comparing the height of the shot with the height of the bore of the Peece assigned.

MAny Gunners hold, that a quarter of an inch space betweene the Bore and the Bullet is vent sutable for all Ordnance, and not too much, nor too little. But others maintaine $\frac{1}{10}$ part of the Diameter of the Peeces Cilinder is more proper and correspondent for al sorts of Peeces whatsoever; take which you please.

To dispart a Peece of Ordnance.

TO dispart a Peece, is to bring the mettall at muzle equall with the mettall at the base ring: In true founded Ordnance, the halfe of the Diamiter of the Cilinder is her dispart: also you may put a priming Iron (such a one as I spake of before, with a Spring and Transome) into the Touch-hole, to the bottome of the concave there, and putting downe the Transome hard upon the superficies of the mettall of the base ring, which resting there, apply the instrument to the muzle, and place him upon the lower most edge of the concave perpendicular,

and raiſe your diſpart from the Muzle-ring as high as the Tranſome, ſo you have laid the mettall at the Muzle in a Horizontall line with the mettall at the baſe ring. But for niceneſſe I would make another diſpart upon the Trunnions, which may be thus done, Lay a peece of ſoft waxe upon the Trunnions, and let one raiſe it in height, I meane, make it longer or ſhorter, untill that the mettall at the top of the baſe ring, the waxe betweene the Trunnions and the diſpart on the muzle ring, be all three of a preciſe height, and in an equall ſtraight line direct.

If I were to fire a Peece of Ordnance at a marke, to gaine credit indeed thereby, I would have a twine ſilke thread that ſhould touch both the tops of the Diſparts, & come to the upper part of the baſe ring upon the midſt thereof, by which thread I would direct my Ordnance to the marke many degrees better.

I could wiſh that the Diſparts ſhould be skrew'd into the muzle ring of the Peeces, that it might bee uſed to that purpoſe, and had alwayes in readineſſe belonging to the ſame Gunne, and upon any occaſion taken out at pleaſure.

Alſo I could adviſe the Sea-gunners upon ſome occaſions to uſe diſparts betweene the Trunnions of their Peeces, made of a juſt heights of purpoſe to ſerve there: let them be tyed about the Peece with a twine, becauſe elſe at every ſhot they will bee to ſeeke, when upon the ſuddaine they ſhould uſe them; which I can by good experience ſpeake, they will much availe, and ſtand you in great ſtead. I could expreſſe divers other wayes to diſpart a Peece, but theſe being ſufficient, I hold it needleſſe to ſpend time, and fill this little treatiſe with unneceſſary Inſtructions.

As in the voyage I made this laſt Spring to the Straits mouth, where wee were in fight, being a ſingle Ship, with five Turky men of Warre.

To

The Geometricall finding the Diameter for the weight of any ſhot aſſigned.

SUppoſe your ſhot bee one, two, or three pound weight of metall or ſtone aſſigned, if of one pound divide the Diameter into 4. parts, and five ſuch parts will make the Diameter of a ſhot of the ſaid metall or ſtone, that ſhall weigh juſt two pound.

Divide the Diameter of a ſhot weigheth juſt 2. pound in 7. equall parts, and 8. ſuch parts will make a Diameter of a ſhot of 3. pound. And divide the Diameter of a ſhot of 3. pound into 10. equall parts, and 11. ſuch parts maketh a ſhot of 4. pound

Divide the Diameter of a ſhot of 4. pound into 13: parts, 14. ſuch parts will make a Diameter for a ſhot of 5. pound.

And ſo dividing each next Diameter into 3. parts, equall more than the next leſſer was divided into; and it will with one part added from a Diameter of a ſhot, that will weigh juſt one pound more: So you may proceed infinitely increaſing, or decreaſing by taking one part leſſe then it is appointed to be divided into.

To tertiate a Peece of Ordnance.

THere are three differences in fortification of each ſort of Ordnance, be they of Cannons, or Culverings; for they are either ordinary fortified, leſſened, or double fortified, as legitimate Peeces, baſtard Peeces, or extraordinary Peeces. For the Cannon double fortified, hath fully one diameter in thickneſſe of metall at her Touch hole, and $\frac{11}{16}$ at her Trunnions, and $\frac{7}{16}$ at her muzzle. And the leſſened Cannons have at their Touch-hole but $\frac{3}{4}$ and at the Trunnions $\frac{5}{16}$ and at the muzzle $\frac{1}{16}$

whereas the ordinary fortified Cannons have $\frac{7}{8}$ at the Touch-hole, and $\frac{1}{8}$ at the Trunnions, and $\frac{1}{8}$ at the muzle. Now all the double fortified Culverings, and all leſſer Peeces of that kind, have one Diameter, and $\frac{1}{8}$ at the Touch-hole, and $\frac{11}{16}$ at the Trunnions, and $\frac{2}{16}$ at the muzle. And the ordinary forified Culverings are fortified every way like the double fortified Cannons. And the leſſened Culverings like the ordinary fortified Cannons in all points.

The difference betweene the common legitimate Peeces, and the baſtard peeces, and extraordinary.

COmmon or legitimate Peeces are ſuch Ordnance, as have a due length of their Chaſes, proportioned according to this height of their proper bores. Baſtard peeces are ſuch as have ſhorter Chaſes than the proportion of their bore doth require. And extraordinary peeces are ſuch Ordnance, as have longer chaſes than the proportion of the bore alloweth: And theſe are called Baſtard Culverings, and extraordinary Culverings, ſo likewiſe of Saker and Faulcon.

To coole a Peece of Ordnance, when ſhe is growne hot with overmuch fiering.

IF you cannot have time to reſt her, becauſe the Service is hot, as it was with us at *Bargen*, in that caſe ſhe muſt be coold with ſpunges wet in lee and water, or water and vinegar, or with the cooleſt freſh or ſalt water, bathing and waſhing her both within and without, untill ſhee come unto her due temper, but if time would permit, reſt her one or two houres in twelve, and coole her as before every eighth or tenth ſhot.

Reaſons

Reaſons that cauſe a Shot, though well directed, to erre in her charge, and to be either wide, ſhort. or over at the marke.

MAny accidents may make a ſhot to deviate from the expected courſe, though well directed. As if the ſoule of the peece lyeth awry in the body of her metall And if the Trunnions alſo be not duely placed directly in a Diagonal line with the Axis of the peece. If the platforme be unequall. Alſo if the Gunner ſhoot without a juſt diſpart. If one wheele bee higher than another. If the naves be one longer and wider than the other. When one wheele meetes with a ſtone to ſtay it: or that one wheele reverſeth in ſoft ground, and the other in hard. The Carriage or Trunnion eares are higher one than another. If the cariage be too wide, ſo that the peece lyeth not faſt therein, but ſtarteth in her diſcharge. If the ſhot be not equally round, the winde, if vehement, may ſomewhat hurt. The ſlight ramming, leaving ſpace betweene powder, wad, and bullet, may alter her courſe. Theſe and many more, are true and infallible cauſes of the failing of a ſhot at an aſſigned marke, yet the peece well directed.

The difference betweene ſhooting by the metall of the peece, and the diſpart.

THeir differences are uncertaine, by reaſon there are ſeldom any cõſtant proportion held in the founding eſpecially concerning the eminencies of their muzle and baſe-ring: for laying the peece directly to the mark, with her due diſpart, and then take of that diſpart, and lay her by the metall, obſerve the difference with a ſquadrant, and you ſhall ſometimes finde that the peece will bee elevated more by the mettall than by the diſpart, foure, five,

five, yea ſometimes ſixe or ſeven degrees. And ſo conſequently will the randons of the metall bee more than the randons of the diſpart, (which by the table of *Ranges*) may for every elevation be made certainly knowne; but this take for an example, on the levell the metall rangeth neare double the diſtance of the diſpart in moſt peeces.

To know at how many degrees of mounture a Peece will convey her bullet fartheſt, called her beſt Randon.

THe approved beſt Artiſts of late times, maintaine with good reaſon, that the utmoſt degree of Randon is at or about 24. degrees of the quadrant, nevertheleſſe moſt ancient authors hold 45. being the middle or meane between the levell and the perpendicular; namely, the halfe of 90. degrees. But becauſe the peece rangeth a bullet but one tenth part of the utmoſt randon as it doth alſo at 84. degrees of the elevation, therefore it ſtands with more reaſon, and experience alſo hath found, that the utmoſt randon of any peece ſhould be (being duely charged & diſcharged) at 42. degrees, the halfe of 84 the elevation.

A neceſſary Table of Periors and Drakes proportioned.

Names of Peeces.	Height of the bore in inches	Length in Diameter.	Weight in met. pound	Weight of Powder.	Length of the Ladle.
Canon Perior.	9. 10. 12.	8	3500	3. 3 1/3 4.	3
D. Canon Drake	6 1/2	16	3000	9 pound.	4 1/2
Culvering Drake	5 1/2	16	2000	5	4 1/2
D. Cul. Drake.	4 1/2	16	1500	3 1/2	4 1/2
Saker Drake.	3 1/2	18	1200	2	4 1/2

A

A Table truely proportioned for our Englisb Ordnance.

Bore.	Height of Shot.	Weight of Shot.	Ladles length.	Ladles breadth.	Length of the peece.	Weight of the peece.	Weight of Corne Powder.	
Inches.	Inches.	Lib.	Inches.	Inches.	Foote.	Lib.	Lib.	
8	7 1/4	63	24	14	12	8000	27	Canon Royall
7	6 1/4	39	22	12 1/4	11	7000	18	Cannon of
6 1/2	6 1/4	30	21	11 1/2	10	6000	14	De. Cannon.
5 1/4	4 1/4	15	19	9		4300	10	Culverin;
5	5	15 1/2	20	10	12	4400	12	
5 1/2	5 1/4	20	21	11		4600	15	
4 1/4	4	9	17	7		2200	6	De. Culvering.
4 1/2	4 1/4	10 1/2	18	8	11	2400	7 1/4	
4 1/4	4 1/2	12 1/2	19	9		2500	8	
3 1/4	3	5	30	9		2400	4	Saker.
3 1/4	3 1/2	5 1/4	31	9	9	1500	4 1/4	
4	3 1/4	5 1/2	32	10		1600	5 1/2	
3	2 1/2	3	25	5 1/2	7 1/2	1200	3	Minions.
2 1/4	2 1/2	2	22	5	7	700	2	Faulcon.
2 1/4	2	1 1/7	18	3 1/6	6	500	1	Faulconet.
1 1/2	1 1/4	3 4	11 1/2	2 1/2	4	300	1/2	Rabinet.
1/4	1	1/2	9	2	3 1/2	202	1/2	Base.

A Table of Randons for the ſixe firſt poyntr of the Quadrant.

	1	2	3	4	5	6
Faulconet	375	637	795	885	892	900
Eaulcon.	550	935	1166	1254	1309	1320
Minion.	450	765	954	1026	1071	1080
Saker.	625	1062	1325	1425	1487	1500
D. Culvering.	725	1232	1537	1653	1725	1740
Culvering.	750	1275	1590	1710	1785	1800
Demi-Canon.	625	1062	1325	1425	1487	1500
Canon of 7.	675	1147	1431	1489	1606	1620
Double Canon.	750	1275	1660	1710	1785	1800

The uſe of this Table.

FIrſt, by this Table, having reſolved upon the poynt of mounture, looke againſt the name of the Peece, and right under that poynt in the common angle, you ſhall find the number of paces of her Randon ſought.

A Table of the proportion of right ranges and firſt what a Range is.

A Right Range in any peece is indeed ſo farre as the Bullet is carried violently in a ſtraight line, which by ſome Gunners of theſe our moderne times, is by them properly called the *Right Range.* This kind of ſhooting is ſo farre as a marke is within the ſtraight line of a Peece, which for ſome elevations and mountures is much more than for others: for that the more a peece is mounted, the farther ſhe conveyeth her ſhot in a right Range.

A Table of right Ranges.

0	192
1	209
2	226
3	243
4	260
5	277
6	294
7	311
8	328
9	345
10	362
20	532
30	702
40	872
50	1042
60	1212
70	1382
80	1552
90	1722

The uſe of this Table, with a plaine Example.

HAving found by experience, that at 60 degrees of mounture the peece aſſigned ſhot 200 paces in a right line, and would know how far the ſame Peece would ſhoote in a ſtraight line being mounted to 10 degrees, ſay by the Table, if 285, the number againſt 6 degrees, giveth 200 paces, what will 354, the number therein againſt 10 degrees give? Multiply 354 by 200, the product will be 70800, which divided by 285, produceth in the quotient 283 paces, and $\frac{141}{285}$ parts.

Of ſhooting at randon at a Marke beyond the right line of the Peeces reach, or right range of the ſhot, and of the dead range of any Peece at every degree.

THe dead range conſiſteth of the addition of the right and crooked ranges together into one, and that called the dead Range, which is the whole diſtance from the plat-forme unto the firſt graze of the Bullets, whereby for the firſt ſixe points of the Gunners quadrant, you having the dead range of one ſhot made out of any Peece; whether it be of a Culvering, (which is betweene 30. and 40. Diameters of her bore in length) by the range of numbers ſet againſt the letter S. in the Table here underneath; or whether it be of the quality of a Cannon, (that is betweene 18. and 24. Diameters of her bore in length by the ranke of Numbers ſet againſt the letter C. in the ſaid Table) you may, having one ſhot, by that ſhot, and by the rule of proportion, know the dead range of any other point of mounting ſought.

Example.

SUppoſe a Culvering that ſhooteth levell 260. paces, I would know how farre ſhe would convey her ſhot upon an Horizontall plaine, ſhe being mounted to the third point of the quadrant. Say by the rule 3. if 192. (the number againſt S.) for the levell range in the Table giveth 2032, the number under the third point, what will 260. give? Multiply 2032 by 60, and divide that product by 192, and you ſhall have in your quotient $2751\frac{128}{192}$ for the number of paces ſhee will convey her ſhot, being ſo mounted.

The Table of dead Ranges.

	0	1	2	3	4	5	6	Points
S	192	985	1623	2032	2185	2281	2300	Paces.
C	201	958	1600	1983	2135	2232	2250	Paces.

To know how the range of his Peece increaseth, or decreaseth from degree to degree.

FIrst, you must finde by the table of right Ranges how much your levell right Range of your Peece is, which number of paces divide by 25, and multiply the quotient by 11, and the product will be the first and greatest digression, which is betweene the first and second degrees, which divided by 40, the degrees contained betweene the first degree, and 42 the utmost Randon, and the quotient sheweth the number of paces that the shot shall loose at every digression, from degree to degree, to the last Randon, and contrariwise for the increasing digression from 42 degrees, the utmost Randon downe to the first degree.

How to finde the right Line, or right Range of any Bullet for every elevation by any one right or dead Range given for the Peece assigned.

AS for example, you are to seeke the right Range of 30 degrees for that peece, whose dead Range for 30 degrees is knowne to be 2200 paces, by it multiply the tabular number of right Ranges for 30 degrees, which are 695, and divide the product by 2150, the tabular number for 30 degrees in the Table of dead Ranges, and the quotient will bee 711 paces for the right Range of that peece mounted and discharged at 30 degrees elevation.

Another Example.

SUppose the levell right Range is given, and the right Range of 30 degrees sought, say, if 192 the first number in the Table of right Ranges, give 695, the tabular number therof for 30 degrees, what shal 197 paces give, the levell right Range given be, multiply and divide, and the quotient will bee 713 paces, for the right Range sought.

To finde how much of the Horizontall line is contained directly under the right range of any ſhot.

TO finde what part lyeth under the right Range at 30 degrees elevation, the right Range at 30 degrees by the precedent example being found to be 713 paces, and the right ſigne of ſixty grades, the complement of 30 being 866, which multiplyed together, and the product divided by 1000, the whole ſigne leaveth in the quotient 621 $\frac{222}{1000}$ for the number of paces lying directly under the right Range.

To finde how much of the Horizontall line lyeth under the crooked Range of a ſhot made out of any peece of Ordnance at any elevation aſſigned.

THe crooked Range is ſo much of the courſe or way as the ſhot maketh as it goeth Helically between the right Range and the natural motion, or before it maketh the firſt graze; And may be thus found by deducting of the levell diſtance contained directly under the right line, or right Range of any ſhot made (found by the precedent Chapter) out of the dead Range thereof, found by the Chapter before going. For the remainder will be the paces, or other meaſures lying directly under the crooked Range.

To make a good ſhot in a peece not truly boared, and to know how much any peece will ſhoot amiſſe, the metal thicker of one ſide than another.

SVppoſe a Cannon is ſaid to bee two inches thicker of one ſide in her mettall, than another, the diſtance to the mark ſuppoſe to be 500 paces. that is 2500 foot, the which divided by 9 foote, the juſt length of the Cillinder of the peece, yeeldeth in the quotient 277 foote $\frac{1}{9}$ that againe being multiplyed by $\frac{1}{2}$ the ſuperfluity of the mettall being 1 inch, makes ſtill 277 $\frac{1}{9}$, which is the true demand ſought.

To

To remedy a Peece not truely bored.

SEarch the peece with an inſtrument to know which is the thicker ſide, then divide the over plus of the metall in two parts, as before, ſuppoſe 2 inches, ſetting the diſpart of your peece on that part to wards the thickeſt ſide of the peeces muzle, and bringing the middle part of the metall at the baſe ring to that diſpart and the upper part of the marke all in one line, fire her, and without queſtion you make a very good ſhot, care being taken in loading.

If the thicker part of her metall be above, then you ought to make your diſpart one inch more: if under, one inch leſſe.

To chooſe a Peece to ſhoot at ſingle marke, the courſe alſo to be obſerved therein.

BY my will I would chooſe a peece as I had formerly practiſed in, and well examined her qualities; and when I came to load her, I would not ramme home her powder any thing hard, but very eaſie, leaſt in taking fire, it ſhould lye blowing firſt, and cauſe the peece to ſtart from her poſition, but let her be duely directed by a true diſparture, that the axes of her bore may preciſely reſpect the marke. And laſtly, endeavour heedfully to prevent all impedimentall accidents which otherwiſe may happen, and give fire.

Having found the firſt Shot faulty to the right or left hand, over or under, to amend the next time, and make an effectuall ſhot.

IF it were wide towards the right or left hand, I would place my eye on the baſe ring at the next time, a little more to the ſame ſide accordingly more or leſſe; if it were too high, direct the diſpart under the marke as much: if two low, lay ſome ſmall ſtone, or other thing, on the higheſt of the baſe ring, and by that bring the diſpart and the marke into one with diſcretion.

How to plant Ordnance in ſecret and double Batteryes, ſo they may not eaſily be diſmounted.

THey muſt be planted upon a platforme that diſcendeth behind, that in their reverſe they may go under the vamure of the Tronier, the Tronier being vaulted, they muſt by tackles bee brought up above the vamure, and opened, and fire given immediately at the opening, ſo in their reverſe will they be againe under the vamure, and be free from diſmounting, ſo long as the furne-mouth and vamure is able to keepe from the ruine of Counter-batteries.

Take this by the way for a note, that a Cannon at 120 Paces, will pierce a wall or rampart, meanely ſettled, onely 10 or 12 foot, but in cloſe ſandy ground, 20, or 24 foote deep: And that a Cannon may being well fortified and diſcreetly managed, be diſcharged 100 times in one day.

Note that a Cannon with one ſhot will ruine more than a 100 hods of earth can repaire.

Further note, that 1000 ſhot made out of 10 Cannons will ruine more than 1500 ſhot can do out of made out of 5 Cannons: And leſſe can the enemy repaire the firſt than the laſt; for a Cannon ſhot made every eighth part of an houre, at 100 paces diſtant, will make as much ruine as twelve men can keepe in repaire.

To make a ſhot in the night at a marke ſhewed you in the day, how to prepare for it.

I Would firſt lay the Peece preciſely to the marke in the the day, then with a chalke line, dipt in Gum-water, I would ſtrike a right line on the upper part of the metall, from

from the breech to the muzle, upon which I would apply a good Magneticall needle, or flye with a chart exactly divided, and note the interſection; then from the end of the line that was mark't, or ſtricken upon the mettall, I let fall plumbe lines upon the platforme, and at the places where they touch, I knocke in at each a ſmall nayle. Laſtly, with a Quadrant I obſerve the elevation of the concave, or elſe with ſome ſtaffe take the perpendicular height of ſome marke made in the mettall as well at the breech, as at the muzle above the ſaid two nayles: and ſo you may againe lay the peece thereby, alwayes to have the ſelfe-ſame poſition, and ſo ſhoote as certaine at the marke by night, as by day.

To make a good ſhot at an Enemies light in a darke Night, not having any Candle, or other light by.

I Would light two peeces of match, the one as much longer as the other, as the quantity of the diſpart of the peece, and ſet the longer upon the upper part of the Muzle-ring, and the ſhorter upon the baſe ring, ſtill traverſing and quoyning the peece, untill I have brought the light of the Enemies, and the lights of the two matches all three into one line, and ſo give fire.

To order a Peece, to make a good ſhot at a moveable Marke, as at a ſhip under ſayle, Boate rowing, or Horſman riding.

TAke a peece that will reach the Marke in a ſtreight line; then obſerve how the Marke moveth: Next, note the winde if it blowes much, whether ſide-wayes, with, or againſt you, and accordingly take advantage: Then with the diſpart conſidered, obſerve ſome cloud, or marke, or point of land that lyeth in the courſe of his motion, and when according to the ſwiftneſſe thereof he

he is come ſo neare it, as I gueſſe the ſhot and hee may meete at the Marke, I give fire: wherein remember this ſecret of Nature, that any Peece will ſhoote farther from Sea to Land-ward, than from Land to Sea-ward.

To ſhoote at a Squadron of men, and what Peece to chooſe.

ACcording to the diſtance, I would chooſe a Peece that in a ſtreight line can reach the marke, be it with Demi-culvering, Saker, or Faulcon, and plant my peece if I could paralell to the Champion plaine, that the ſhot may range to ſhoote at girdle-height, unleſſe the ground be ſtony; for then would I place my ſhot ſhort of them, that grazing amongſt the ſtones, the ſtones may ſpoile them more than the ſhot of it ſelfe can doe by much; but in no caſe would I ſhoote wide, or over them; for that were both loſſe, and foule ſhame for the Gunner.

To ſhoote farther than ordinary in one and the ſelfe-ſame Peece with like quantity of pouder and ſhot.

IWill gently put home the powder, and wad the ſame accordingly, then the ſhot being involved with paper, leather, okam, or ſuch like, to fill cloſe the concave of the bore, I would drive the ſhot cloſe to the powder with a good wad, putting after it a Tampion of Cork, and with a ſpunge moiſtned with oyle, I would annoint the vacant Cilinder, and ſo barricadoe the peece; that it ſhould not reverſe in the diſcharge.

Of

Of Powder, Peter, and Match.

To refine Salt-peter wet.

TAke what quantity of Salt-peter you pleaſe, and put the ſame into a cleane Caldron, and put thereon a little faire water, and boyle them together untill it raiſe the ſcum; which take off, and keepe, and let it congeale and ſhoote in coolers, as at firſt it did, and what remaines, boyle againe with more cleere water untill it congeale.

To know if Salt-peter be well refined.

TAke and lay it on a board, and put a coale unto it, if it raiſe an azure ſcum, it is yet greaſie, if it leaves pearles it is yet earthly: but if it burne into the board, and leave nothing but a blacke colour, and riſe with a long flamed ventoſity and exhalation, it is well refined.

Severall wayes to know whether powder be decayed or no, whether by moyſture or age, in part or in whole.

IT is the practicke part of a Gunner really to know his powder, and whether it bee decayed or not, by mutation or corruption. And there are eſpecially three ready wayes to finde the ſame. The firſt, by the ſight; the ſecond by the feeling, and the third and ſureſt by firing it. By ſight, if it bee not blacke and darke, but bright, and inclining to a blewiſh tawny colour. By feeling, graſping it in the fiſt, if it run through the fingers quickly, and avoydeth the handling, and cling not together. By fire, if fired, it riſe quicke, and ſpread in a moment, ſmoke little, but riſeth in a cleare flaſh: unto which

adde further, if it leave no feezes, but carry all away, the powder is good, or elſe the contrary may bee judged.

To renew powder decayed in part.

OFtentimes in Forts, but moſt common and uſually at Sea, powder gathereth humid vapours, which will in ſhort time deſtroy the ſtrength and vigority thereof, and makes it of little, and ſometimes of no uſe, without renewing it. And ſometimes it may decay by age. Let therefore the Gunner firſt prove the powder by fire; and if it make a flame with a long taile, that is, if it ſleepe in its burning, more or leſſe, then for every hundred pound of powder, adde foure pound, or ſixe pound of refined Salt-peeter, mixing them well together, and put them to be beaten and wrought for the ſpace of three houres, and then moyſtning, corning, and drying the ſame, as aforeſaid, proving it in meale dryed, how it will riſe by fiering; and ſo doing, the powder may bee made ſerviceable, if the coale be not corrupted.

To renew powder totally decayed.

IF it be wholly decayed, lay a Rayſon frayle, or mat in the bottome of a bucking-tub, upon a fagot made of purpoſe, or lathe, ſet on edge, to keepe the mat from the bottome, and put in ſtraw layd croſſe-wayes: upon which powre the decayed powder, and warme water, being put thereon, and let it ſtand and ſoake ten or twelve houres, that all the Salt-peeter may bee aſſuredly diſſolved: then let out the liquor tap which congeale to Peter, and thereunto adde a due proportion of Coles and Sulphure, and make it into powder, as is formerly taught

for

for the Coles and Sulphure diſſolving, will remaine the ſtraw, fraile, or mat.

To make powder that ſhall not waſt with time.

TAke what quantity of powder you will, and mixe it with *Aquavitæ*, and make it up in balles, and dry them well in the Sunne, or in a warme place, and keepe them in an earthen pot well glazed, untill you have cauſe to uſe them. This powder will not decay, nor waſte with age.

To preſerve powder that is good, and keepe it from decaying.

I Would adviſe every Gunner to chuſe the dryeſt place he can poſſible, to keepe his proviſion and ſtore of powder in, and every fortnight or three weekes at the moſt, to turne his barrels upſide downe, ſo will the Peter bee diſperſt in every place, and be in every part alike, otherwiſe, if it be let ſtood long unremoved, the Peter will (as nature forceth it to its proper element) deſcend for the moſt part, to the bottome of the Barrell, and the upper part will want, and be much weakened, and in time quite decay, and looſe its proper vertue: for one pound of powder in the bottome of any Caske, with long ſtanding, will have more ſtrength than three at the top.

Alſo it were good diſcretion after you have put your powder in Cartredges, to barrell them up, and ſome times to turne them, as aforeſaid. I would adviſe you likewiſe to place all thoſe Cartredges that you keepe and make for your peeces, when they are hot, by themſelves, that you may have them to hand, when need requires.

To make extraordinary Match to fire Ordnance.

TAke as many threeds of groſſe Cotten yarne, as hath not taken Salt-water, and worke them bobbing-wiſe of a compleat bigneſſe, and boyle them in Salt-peeter water, and ſqueeze them, and rowle them on a table, whereon mealed Peter and Sulphure is ſpread: then draw them through the palme of your hand, and dry them well. You may doe it alſo with cotten match.

To make a match will reſiſt fire and water.

TAke Salt-peter refined one part, Sulphire ½ part, and put them into a pot with ⅓ part of Camphiere mealed with the Sulphure, and one part of fine mealed quick lime, with ſo much linſeed oyle and a little liquid verniſh to temper them well together. Then take of Cotton bobbing match, as bigge as your little finger, and put it into the mixture to ſoake over a fire untill it be well imbibed, and have ſoaked up the moſt part of the liquor, then take the feezes or remainder, and put them into the palme of your left hand, and with your right draw the match through it twice or thrice, claſping cloſe your fiſt, that the match may receive the ſubſtance of it thereinto: then dry it upon a line, and keepe it for ſpeciall uſes, for Vaults, Mines, and moiſt weather.

To make a very violent match.

TAke two ounces of powder, foure ounces of Peter, two ounces of *Aquavitæ*, diſſolve them over a fire, and put in your cotten-match, and ſoake it up: if you imbibe the feſills for your rockets therein, it will bee very proper; you may rowle and rub them in meale powder upon a table dry, and keepe them in a dry place, and it will be for your purpoſe.

Of

Of Fire-workes.

To make certaine Fire-workes, very neceſſary both for Sea and Land-ſervice.

TO arme Pikes, to defend a Ship, or breach, or to enter the ſame, or to ſticke in the ſides of a ſhip, or other place, take ſtrong canvas, and cut it in length about a foote, or 14 inches, and ſixe inches high in the Center, and let the ends be both cut taper-wiſe, then faſten the canvas at both ends with ſtrong twine, and fill it with this receipt.

Powder bruiſed 8 parts, Peter in Roch 1 part; Peter in meale 1 part; Sulphur in meale two parts, Rozen Roch three parts, Turpentine 1 part, Verdigreaſe $\frac{1}{2}$ part, Bole-armonicke $\frac{1}{3}$ part, bay ſalt $\frac{1}{3}$ part, *Colophania* $\frac{1}{6}$ part, Arſnicke $\frac{1}{8}$ part, mixe them very ſuently together, and trye them in the top of a Braſſe Candleſticke when the fire doth burne furiouſly with a blew and greeniſh colour, then fill the canvas, and rowle it over, being firſt armed with ſtrong twine all over, with this liquid mixture molten in a pan, Pitch 4 parts, Linſeed Oyle 1 part, Turpentine $\frac{1}{3}$ part, Sulphur 1 part, Tarre $\frac{1}{3}$ part, Tallow one part; and as ſoone as this is cold, bore two holes in each of the ſame next the Iron an inch deepe, with a ſharpe Iron Bodkin, filling the ſame with fine bruiſed powder, and putting in every hole a little ſticke of two inches long, which are to be taken out when yon would fire the ſame, this compoſition will burne furiouſly.

And remember you cut off the ſtaffe ſome three inches from the worke, and put thereon a braſſe ſocket

of five or sixe inches long, and then cut the end of your staffe to fill the socket, for when you fire your worke, you may stick it in the side of a ship, and pull the staffe out againe, so will not the work be so easily avoyded, as when the staffe was on, and hangs at length, because the very weight of the staffe and length thereof, will be a meanes to weigh downe the work, or that the enemy may come, and thereby pul it out, or beate it off quickly, let the composition and worke containe in weight about 7 pounds, then will it doe execution, and worke a better effect, than if it were of lesse weight, by much; by reason the composition else would be wasted, before it comes to effect its execution.

To burne the sailes of Ships a pretty distance, or to fire thatch'd houses, Corne-stacks, or any other combustible matter apt to burne, when you cannot come to the same; it is good to have certaine strong Crosse-bowes to bend with racks or gaffells, and so shoote Arrowes armed at the heads with wild fire, made of the composition as above, & about three inches in length, & one inch and a halfe in the Diamiter, tapred as afore in all poynts: or you may have long bowes, but then let your arrowes be also longer, which for divers services may do great good.

To charge Trunkes.

TO charge Trunkes to shoot little Balles of wild-fire, either to offend or defend, you must first charge him with two inches of good powder, and then with a Ball of wild fire a little lower than the concave of the Trunk, yet the Ball be bored through crosse-wayes, and primed full

full of fine powder. Laſtly, with ſlow receipt, then with powder, then with a Ball againe as aforeſaid, untill you have filled the ſame within $\frac{1}{4}$ of an inch of the mouth, which would be filled up with fine powder and receipt mixed together. Some doe uſe to have at the mouth two Iron ſtirts to ſticke them in the ſide of any thing, or to defend ones ſelfe from the enemy from taking it off with a thruſt while they doe execution.

To make the Ball.

THe Ball of wild-fire muſt be thus made, Take untwiſted match, tow, and hempe, the which would be moyſtned in *Aqua vita*, or boyled in Salt-peter water: then take of bruiſed powder ſixe parts, of Salt-peter one part, of Brimſtone finely beaten, one part, of coale made of light wood moyſtned with a little linſeed oyle and turpentine wrought together, one part: then lay the tow, or okam abroad in thickneſſe of the back of a knife, and as broad as great Oyſter-ſhell, put into the ſame as much as you can graſpe together in your fiſt, and tying the ſame hard with a packe-thread, coate it over with molten brimſtone, and when you would uſe the ſame, bore it through with a Bodkin, and fill the holes full of fine powder bruiſed.

To make Bullets of wilde-fire to ſhoote out of a Trunke, which will be as hard as a ſtone.

TAke Sulphure in meale ſixe part, of Roſen in meale ſixe parts, melting the ſame in ſome pot over a ſlow fire: then take ſtone pitch one part, of hard waxe one part,

of

of Tarre ¼ part, of *Aqua vitæ* ½ part, of Linſeed oyle ½ part, of Verdigreaſe ¼ part, of Campheire ⅛ part, melting all theſe together. Likewiſe ſtirre into the ſame of Peter in meale two parts, and taking it from the fire, put therein foure parts of bruiſed powder, working the ſame well together in your hands, and rowle it round of the bigneſſe you meane to make your balls of, boring two holes through the ſame croſſe-wayes, which muſt be primed with bruiſed powder. Theſe balls being cold, will grow very hard, and fired will burne furiouſly.

To make Hedge-hogges.

TO make Hedge-hogges, or Balles, you muſt fill them with the ſame receipts you doe your Arrowes, and Pikes, and let them be five inches in the diameter, and well armed with twine before you coat them, and after bored two holes, and primed with fine powder: then put in two ſticks, and uſing them, pull them out againe, and at the ſaid holes fire them. The ſpikes ends of Iron muſt bee like Deaths arrow heads, five or ſixe ſtirts a peece, to hang in the ſayles, or ſtick in or upon any place aſſigned: and remember in the arming, to leave a nooſe to throw him being fired, out of your hand.

To make Powder pots.

THey are made of blacke Potters clay, or thick glaſſe, round Bottles with eares to tye matches, lighted at both ends, the pots or glaſſes are to be filled with dryed fine powder, and thrown upon the decks, or other where, which will much prejudice the enemy, and many times fire their owne powder-cheſts.

To

To make Powder-chests.

THey are to be made first of three boords, two to be nayled together like the ridging of a house, and one longer and broader to the bottome thereof: betwene which three boords put your Cartredge, then make it up like a Sea-chest, and fill it with stones, nayles, and what such like you will: then naile the cover on, and the ends to the decks, in such a place that you may fire the powder underneath through a hole made to put a Pistoll in.

To make Roche-Sulphure.

ROche-Sulphure is made, one pound of Sulphure molten on a slow fire, and one quarter of a pound of mealed powder put thereto by little and little, and in the cooling put three ounces of Corne-powder, mixing them well together; to which put one pound of molten suet, so have you made good Roche-Sulphure.

A true receite of a Composition that will burne and feed upon the Water.

TAke Mastick halfe a pound, white Frankinsence, Gumme, Sandrake, Quicklime, Brimstone, Bitumen, Camphire, and of the best and dryest Gun-powder, of each of these one pound and a halfe; Rozin one pound, Salt-peter foure pounds and a halfe, mixe them all together, and you have your desire.

A Receite of a Composition that will burne under water.

TAke Brimstone one pound, Gun-powder ten Ounces, of the best Salt-peter you can get, one pound

and a halfe, Camphire beaten with Sulphur and Quick-silver; mixe them well together with oyle of Peter, or for want of it, let it be Linseed oyle boyled, unill it will scald a Feather: fill a Canvas ball with this Composition, arme it, and ballast it with Lead at the bottome; make a little vent at the top, fire it well, and cast it into the water, and you shall finde the experience worth your labour.

A Receite of a Composition that will kindle with the water.

TAke of Oyle of Tyle one pound, Linseed-oyle three pounds, oyle of yelke of Egges one pound, new quick-lime eight pounds, Brimstone two pounds, Camphire foure ounces, Bitumen two Ounces; mingle all together very well, and you shall have your desire.

How to know the just time or houre, that any quantity of a lighted Match shall doe execution at the time desired.

TAke our ordinary Match which is used for the Musket, rub, or beate it against a post to soften it, then either dip the same in the water of our ordinary Salt-peter; then dry it very well either by the fire, or in the Sun, according as your haste requires: or else beate a little Brimstone very small, and put a little fine Gunne-powder amongst it, and rub the Match with them, being made liquid with a little *Aqua vitæ*, and dryed as before said: then try first how long one yard of this Match thus prepared, will burne, which imagine to be about a quarter of an houre; and if one yard will burne so long, then foure yards will be just an houre: Take therefore as much of this Match as will burne so long as you will have it to be ere your worke should fire, binde the one end unto your worke, lay loose powder well dryed, under

der, and about it lay the reſt of the Match in hollow or turning, ſo that one part of it touch not another, and fire it.

For Fire-pikes 4 pound a peece for one dozen.

Powder 20 pound.
Peter-roch 5 pound.
Peter-meale 5 pound.
Sulphur 3 pound.
Rozen 2 pound ½.
Turpentine 1 pound.
Linſeed oyle 1 pound.
Summe 38 *pound*, 8 *ounces*.

For arming.

Sulphur 6 pound.
Turpentine ½ pound.
Threed 4 pound.
Summe 10 *pound* ½.

For Arrows 2 dozen, each 1 pound.
Powder 12 pound.
Sulphur 3 quarters of a pound
Rozen 3 quarters of a pound.
Roch-peter halfe a pound.
Peter-meale 3 qua. of a pound
Summe 15 *pound* 3 *quarters*.

For coating.

Sulphur 5 pound.
Peter-Roch 2 pound.
Peter-meale 1 pound.
1 yard of Canvas & marle.
Summe 9 *pounds*.

For 2 dozen of balls wetworks of 4 pound a peece.
Powder 48 pound.
Peter-roch 16 pound.
Pitch 2 pound.
Rozen 2 pound.
Turpentine 8 pound ½.
Linſeed oyle 1 pound.
Traine-oyle 1 pound.
Sũme totall 90 *pound* ½

For Coating.

Pitch 14 pound.
Rozen 2 pound.
Sulphure 8 pound.
Canvas 4 yards.
Small Marle 3 pound.
Summe 31 *pound*, ½.

For 1 dozen of pots, each one 1 pound, ¼.
Corn-powder 1 pound ½.
Serp. powder 9 pound.
Sulphure 3 pound.
Peter-roch 1 pound & ½.
Summe 15 *pound*.

For Capping.

Canvas 1 yard.
Okam ¼ of a pound.
Sulphure three fourth pound.
Packthred 1 ounce.
Sũme 1 *pound*, 9 *Ounces*.

A short View of the Chiefest Heads which are contained in this Booke of GVNNERY, Viz.

By

To